

Health Consultation

Drinking and Irrigation Water Quality
Blue Ridge Elementary School
Lakeside, Navajo County, Arizona

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
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Purpose

This health consultation evaluates results of irrigation well samples collected by the Arizona Department of Environmental Quality in October 2003. Previous results obtained by the Blue Ridge Elementary School District in the summer of 2003 indicated trichloroethylene (TCE) levels above the U.S. Environmental Protection Agency's (EPA) Maximum Contaminant Level (MCL). In addition, the most recent (2002) Annual Water Quality Report from the drinking water supplier, Arizona Water Company, was reviewed.

Background and Statement of Issues

A previous health consultation (*Blue Ridge Elementary School, Lakeside, Navajo County, Arizona Health Consultation-April 30, 2003*) reviewed environmental conditions at Blue Ridge Elementary School. Parents and school staff were concerned that environmental exposures were causing students to be absent from school. Drinking water quality reports, indoor air quality data, food safety, environmental sanitation records, student attendance rates, and the results of an annual parent satisfaction survey were evaluated in the consultation. Arizona Department of Health Services (ADHS) concluded that environmental conditions at Blue Ridge Elementary School posed no apparent public health hazard, and that attendance rates were similar to statewide attendance rates.

As part of the 2003 health consultation, ADHS requested that the school district conduct water sampling from the on-site irrigation water wells for the school grounds. Those sampling results were not available when the 2003 health consultation was completed.

The school was built in 1974 and is located at 1200 West White Mountain Boulevard in Lakeside, Arizona. Lakeside is on State Highway 260, southeast of Show Low in southern Navajo County. The Blue Ridge Elementary School has 700 students enrolled in kindergarten through 3rd grade, and employs 75 teachers and support staff (1).

Drinking Water Quality

The Arizona Water Company provides drinking water to Blue Ridge Elementary School from wells located throughout the Lakeside area. Our April 2003 health consultation reviewed the water company's annual reports from 1997 through 2001. Industrial solvents or gasoline components were not detected in the Lakeside drinking water, and levels of naturally occurring elements (such as aluminum, calcium, iron, and magnesium) were below levels of concern. These facts suggested that the drinking water at the school did not represent a health threat.

A review of the 2002 annual report indicated that drinking water supplied to Blue Ridge Elementary School continues to meet all state and federal safe drinking water standards (2).

Irrigation Water Quality

The Blue Ridge Elementary School grounds are flood-irrigated with groundwater from a water storage tank that collects groundwater from the two on-site wells. At the time of the April 2003 health consultation, current water quality data for the irrigation well water was not available. The school maintenance supervisor reported that past sampling results from the wells had been acceptable. The school district obtained a composite water sample in the summer of 2003 from the water storage tank at the request of the Arizona Department of Health Services. The sample

results exceeded the Maximum Contaminant Level (MCL) of 5 parts per billion (ppb) for TCE in drinking water. This sample was taken from the water storage tank and included water from both on-site irrigation wells.

The Arizona Department of Environmental Quality (ADEQ) collected additional groundwater samples in October 2003. The samples collected by ADEQ from the two irrigation wells and two storage tanks were analyzed by the Arizona State Laboratory for volatile organic compounds (VOCs). TCE was the only contaminant detected (Table 1) in these samples.

While results confirmed the presence of TCE in groundwater, the source is not known and is being investigated by ADEQ. School officials were informed of sample results and this consult has been prepared to document our assessment process.

Table 1: Irrigation Water Sampling Results

Sample Location	TCE (trichloroethylene) concentration (micrograms per liter, µg/l)	Above MCL? (5 µg/l)
Irrigation Well #1	5.3	Yes
Irrigation Well #2	2.3	No
Irrigation Water Storage Tank (Sample #1)	2.5	No
Irrigation Water Storage Tank (Sample #2)	2.5	No

Discussion

Irrigation Well #1 is only used for on-site irrigation. The school maintenance supervisor stated that the school grounds are irrigated when it does not interfere with student use during the school day. During summer months, some irrigation does occur during daytime hours. The maintenance department avoids irrigating when it will leave the fields wet for scheduled events. The frequency and amount of irrigation needed during the school year and the winter months is limited because the average snowfall for Pinetop-Lakeside is 47.2 inches per year (4).

Limited dermal, inhalation, and ingestion exposures are possible for anyone who contacts the contaminated irrigation water (Table 2).

Table 2. Completed Exposure Pathways

Source	EXPOSURE PATHWAY ELEMENTS				Contaminant of Concern
	Media	Point of Exposure	Route of Exposure	Estimated Population	
Irrigation Well #1	Groundwater	Irrigation water	Inhalation Dermal Ingestion	700	TCE

Exposures were calculated for children, as they are the most sensitive population. We estimated exposures to irrigation water containing trichloroethylene by assuming that children play in the

flood irrigation water for one hour, 24 times per year (once per week for 6 months) for 12 years. We assumed that a child would incidentally ingest 0.05 liters (50 milliliters) during each play event, and used a child body weight of 15 kilograms (5).

Our estimated exposure dose is based on the maximum concentration detected and represents a “worst case scenario.” The ingested dose from drinking water was doubled in order to take into account skin absorption and inhalation of vapors resulting from contact with the irrigation water. The assumption is that the combined dose from these two routes of exposure is equivalent to that of ingestion (6). Childhood doses were compared to the chronic ATSDR Minimal Risk Level for chronic ingestion of trichloroethylene, which is an exposure dose below which no adverse, non-cancer health effects are expected.

Table 3. Well #1. Trichloroethylene (TCE) Non-Cancer Estimates

TCE concentration (mg/L)	Pathway	Child’s Estimated Non-cancer Daily Dose (mg/kg-day)	Health Guideline (mg/kg -day)	Exceeds Guideline?	Source
5.3	Inhalation	0.12	Not available	--	-
5.3	Dermal	0.001	Not available	--	--
5.3	Ingestion	0.046 ¹	0.20	No	MRL ²

¹ The exposure dose calculated for ingestion (0.023 mg/kg-day) was doubled to take into account exposures from inhalation and dermal contact.

² MRL: Health-based comparison values have been developed by ATSDR for chemical in various environmental media. The values define the concentration at or below which carcinogenic and/or noncarcinogenic health effects are not likely to occur after exposure. Contaminant concentrations exceeding these values do not necessarily pose a health threat, but have been further evaluated to determine the potential for health effects.

Trichloroethylene (TCE)

Trichloroethylene is a man-made chemical originally developed as an anesthetic for surgery. It is used today as an industrial cleaner to remove grease from metal parts. It is also used in many consumer products, including typewriter correction fluid, paint removers, paint strippers, adhesives/glues, spot removers and cleaning fluids for rugs. At room temperature, TCE is a colorless liquid. It has an odor similar to ether or chloroform, and evaporates very quickly.

Health effects from exposure to TCE vary depending on the amount to which a person is exposed and how long the exposure lasts. Dizziness, headaches, slowed reaction times, sleepiness, and facial numbness have occurred in workers breathing TCE or in people who use products containing TCE in poorly ventilated areas. Concentrations causing these effects are higher than the allowable occupational exposure level of 50 parts per million. Irritation of the eyes, nose, and throat also occur under these conditions. More severe effects on the central nervous system, such as unconsciousness and possible death, can occur from drinking or breathing higher levels of TCE. The effects caused by exposures to TCE disappear when the exposure ends. Levels of TCE in the normal environment are generally well below levels of those found in the workplace.

Studies in animals show that ingesting or breathing levels of TCE that are higher than typical environmental levels can produce nervous system changes, liver and kidney damage, effects on the blood, tumors of the liver, kidney, lung, and male sex organs, and possible cancer of the tissues that form the white blood cells. Results of a few studies in some pregnant animals

exposed to TCE in air or food showed effects in unborn animals or in newborns. None of these effects have been definitely shown to occur in humans.

The U.S. Environmental Protection Agency is currently reevaluating the carcinogenic classification for TCE. The International Agency for Research on Cancer (IARC) has determined that TCE is a probable human carcinogen based on limited human data and sufficient data in experimental animals. (3)

Child Health Issues

All exposure dose estimates were calculated assuming childhood exposure, thus incorporating exposure assumptions that reflect a child's greater intake of water relative to body weight. All conclusions and recommendations about using water from these wells were based on the characteristics of this sensitive population.

Conclusions

Based the levels of TCE found in water samples from Irrigation Well #1 and the exposure scenarios used in our assessment, the use of Irrigation Well #1 for watering the school grounds poses **no public health hazard**.

The TCE levels found in the irrigation wells pose no apparent health hazard to children who play in, or come into contact with, the irrigation water.

Groundwater samples from irrigation well #1 contained TCE levels slightly above the Maximum Contaminant Level for drinking water. Water from this well is used solely for flood irrigation of the school grounds and is not a source of drinking water. The source of the TCE is unknown and is currently being investigated by ADEQ.

Based on a review of the most recent (2002) Annual Water Quality Report from the Arizona Water Company, drinking water supplied to the school meets all federal and state standards.

Recommendations

The Arizona Department of Health Services will review the 2003 Annual Water Quality Report from the Arizona Water Company when it becomes available.

Public Health Action Plan

The Arizona Department of Health Services has worked with the Blue Ridge School District to address public health-related concerns and provided an interim update on sample results until this consultation could be completed.

This health consultation will be distributed to the ADEQ Water Quality Assurance and Revolving Fund Program. It will also be sent to the Blue Ridge Elementary School District.

References

1. Arizona Department of Health Services. Blue Ridge Elementary School, Lakeside, Navajo County, Arizona Health Consultation. April 2003.
2. Arizona Water Company. 2002. 2002 Annual water quality report for Lakeside, Arizona PWSID #09-003--.
3. Case Studies in Environmental Medicine. ATSDR. January 2001. U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry, Division of Health Education and Promotion).
4. Arizona Department of Commerce. Phoenix, AZ 9/2003) <http://www.azcommerce.com>.
5. U.S. Environmental Protection Agency (U.S. Environmental Protection Agency). 2002. Child-specific exposure factors handbook. National Center for Environmental Assessment, Washington D.C.; EPA 600/p/00/002B. National Information Service, Springfield, VA:PB2003-101678.
6. Washington State Department of Health. Health Consultation. Cadet Manufacturing. Vancouver, Clark County, Washington. January 2002.

PREPARERS OF REPORT

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CERTIFICATION

The Arizona Department of Health Services, under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), prepared this health consultation on drinking and irrigation water at Blue Ridge Elementary School, Lakeside, Navajo County, Arizona. It was prepared in accordance with approved methodology and procedures existing at the time.

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The Division of Health Assessment and Consultation has reviewed this health consultation and concurs with its findings.

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